



**WEBINAR SERIES ON
BIOTECH INNOVATIONS FOR A
SUSTAINABLE AGRICULTURE**

Biotechnology and Aquaculture: Meeting Growing Seafood Demand Sustainably

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- ✓ **The Philippines** have a total area of **2,200,000 km²** total length of **36,289 km coastline**.
- ✓ **Fishing** is one of the major sources of livelihood in the country where there were about **1.99 million fishers** and **0.35 million fish farmers** in **2019**.
- ✓ **11th** in aquaculture production in **2019**.
- ✓ **1.50 million MT in Seaweeds Production (2021) – 4th largest producer** of aquatic plants.

Source: 2021 Philippine Fisheries Profile



- ✓ **2.19 million** fisherfolks engaged in fishing activities
- ✓ **USD 1.89 billion** aquaculture production including fish, crustaceans, and mollusks total value
- ✓ **40 kg/year** average per capita Filipino fish consumption

Total fishery production of the Philippines by quantity (MT)

	2020	2019	2018	2017	2016	2015
Total	4,398,589	4,413,129	4,613,074	4,312,663	4,350,761	4,645,871
Capture Fisheries	2,075,758	2,054,891	2,308,709	2,074,876	2,149,847	2,297,712
Marine Capture	1,927,343	1,900,210	2,145,735	1,911,006	1,994,338	2,094,346
Inland Capture	148,415	154,681	162,974	163,870	155,509	203,366
Aquaculture	2,322,831	2,358,238	2,304,365	2,237,787	2,200,914	2,348,159

Source: *Fishery Statistical Bulletin of Southeast Asia 2020*

Source: 2021 Philippine Fisheries Profile
FAO United Nations 2020

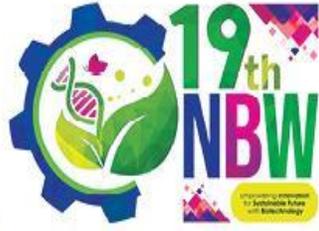


Aquaculture is practiced in **freshwater, brackish and marine water** using a variety of species

Top 15 aquaculture-producing countries **worldwide** and within the **top 5 in Southeast Asia.**



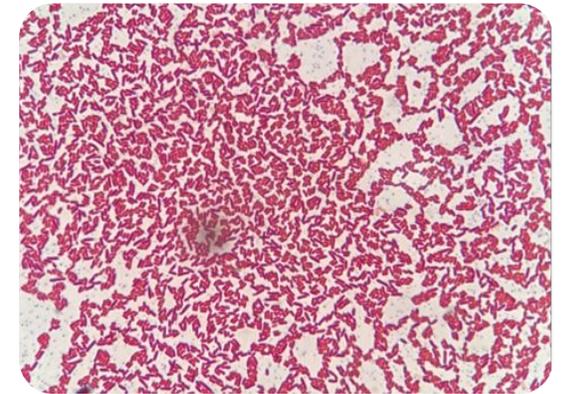
- ✓ **Aquaculture** the country's main source of fish
- ✓ **Tilapia, milkfish and shrimp** common farmed species
- ✓ Recorded **decreasing** over the years
- ✓ Due to **large exploitation**



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Challenges in Aquaculture

- ✓ **Emerging diseases** and **trans-boundary movement** of aquatic animal diseases
- ✓ **Resiliency of the fisheries industry** from climate change, calamities, economic shocks, and the pandemic
- ✓ **Decrease of production** over the years



BIOTECH IN FISHERIES



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TRADITIONAL



Patis, Bagoong,
etc.

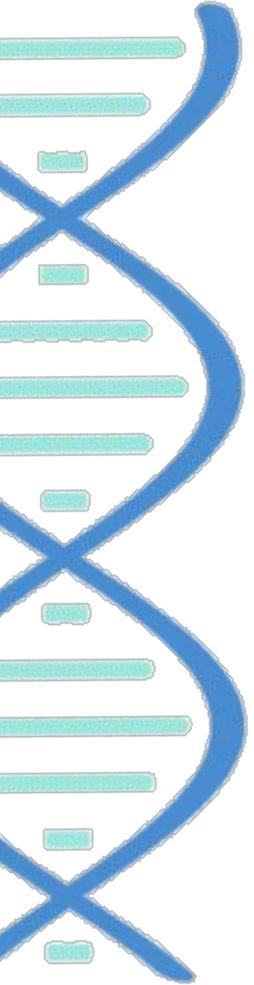
- Tissue culture (micro propagation)
- Bio-fertilizers
- Bio-control agents
- Vaccines, Probiotic

MODERN

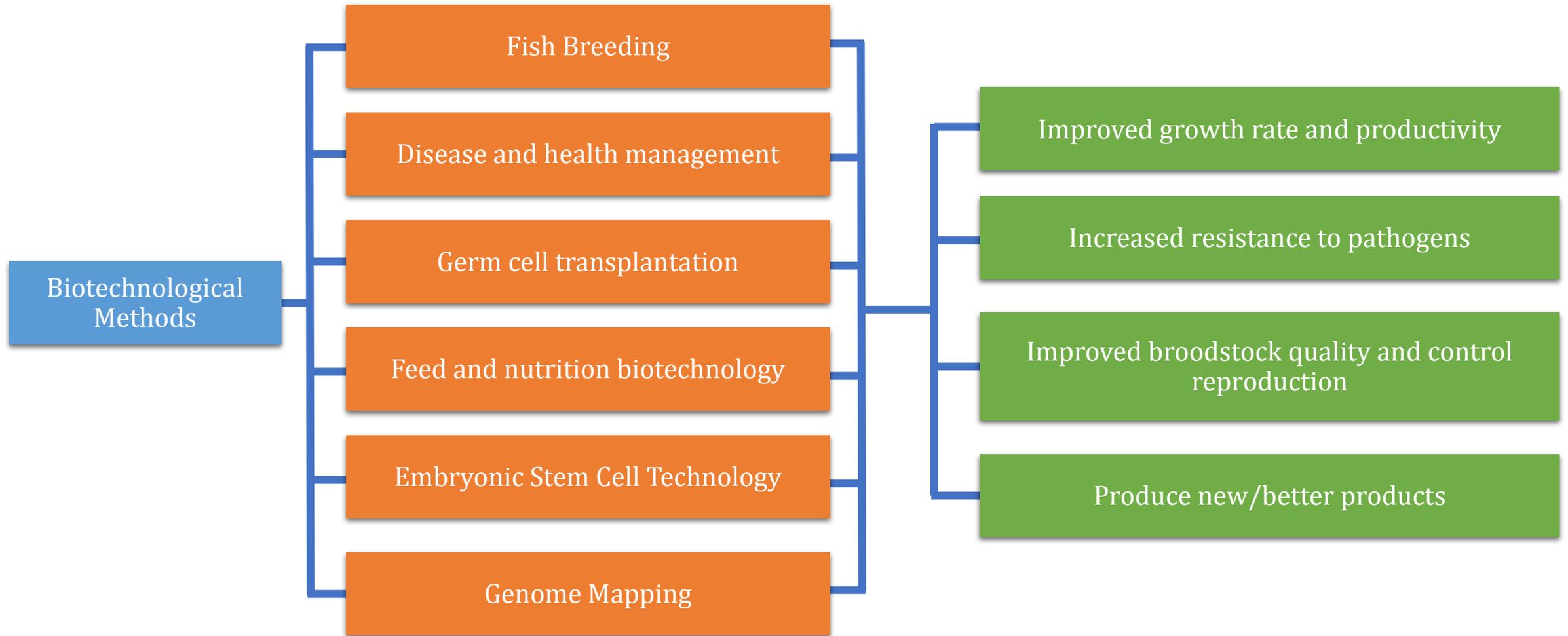


Transgenic
Glow Fish

- Marker technologies
- Genomics and other “-omics” technologies
- CRISPR technology
- Genetic engineering



APPLICATION OF BIOTECHNOLOGY IN AQUACULTURE



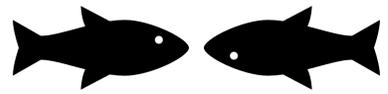
BIOTECHNOLOGY TOOLS IN FISHERIES



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BIOTECHNOLOGY

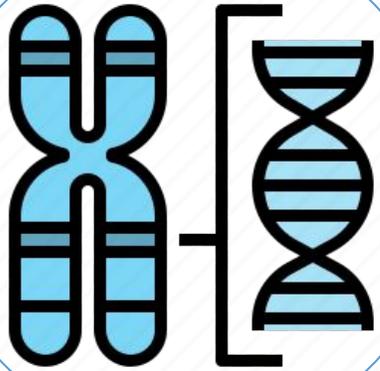




Fish Breeding

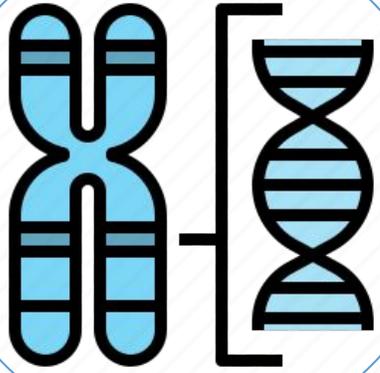
- Induced breeding - Gonadotropin releasing hormone (GnRH).
- GnRH analogue profusely used now in fish breeding and marked commercially under the name of “Ovaprim”.





New breeding techniques

- **Natural and artificial selection**
 - **Natural Selection:** The process by which favourable traits that are inheritable become more and more common in a species when individuals are allowed to breed naturally.
 - **Artificial Selection:** The controlled breeding of a species to encourage certain traits over others
- **Artificial sexual hybridization-** hybridization among distantly related fish species
- **Nuclear transplantation-** to transfer a diploid nucleus into an enucleated egg for investigating the roles of nucleus in initiating embryonic development
- **Gene transfer-** transfer of genetic materials



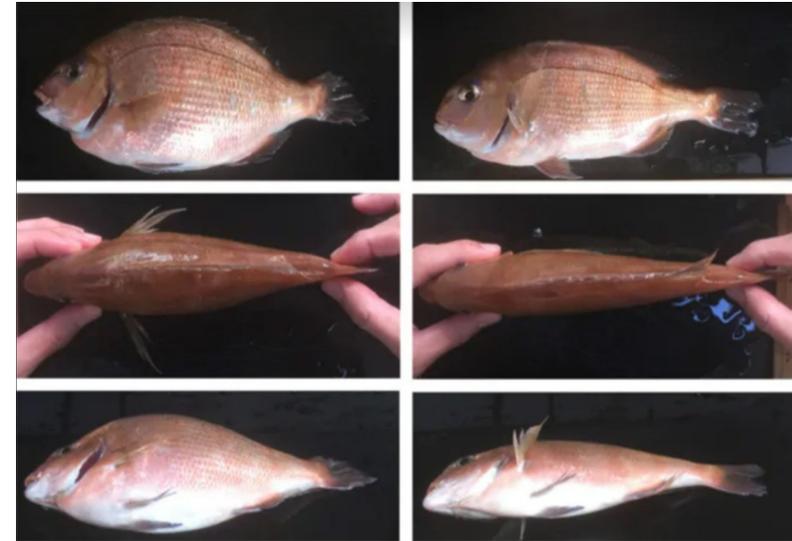
New breeding techniques

□ Transgenic Salmon

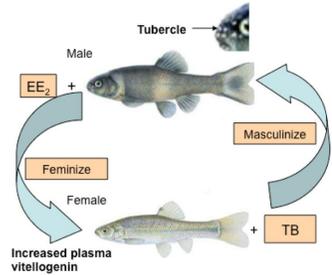


<https://thefishsite.com/articles/genetically-modified-salmon-changing-the-future>

□ CRISPR technology



Sex Control and Transgenesis



Sex Control

- The process of sex differentiation in teleost is protracted and labile rendering the hormonal induction of sex reversal possible in gonochoristic and hermaphroditic species.

Transgenesis

- Opportunity for modifying or improving the genetic traits of commercially important fishes, mollusks and crustaceans for aquaculture.

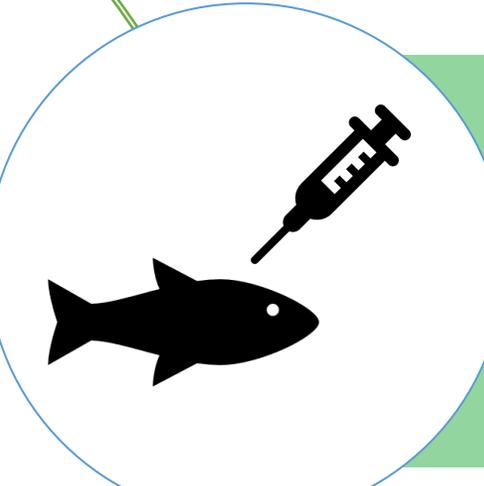


Aquaculture Nutrition

The use of biotechnologically improved products and appropriate use of locally available feed ingredients in semi-intensive aquaculture is still needed.



SEAFDEC-AQD



Fish Health Management

Molecular diagnostic methods, use of vaccines and immuno-stimulants are gaining popularity for improving the disease resistance in fish and shellfish species.





Molecular Biology

Genetic identification of aquaculture stocks is a fundamental requirement in any culture programme.

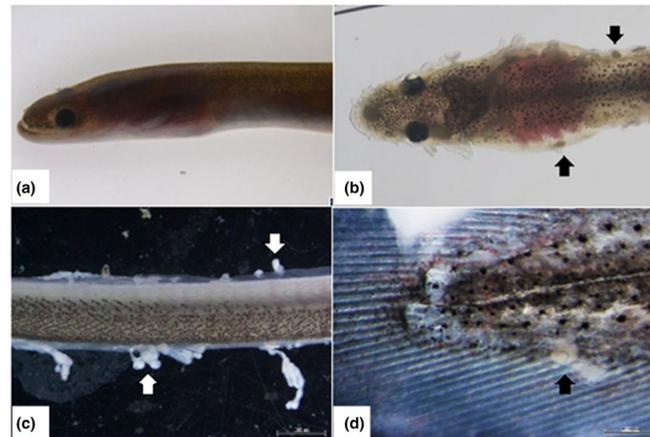


FIGURE 1 Ichthyophthiriasis in a tank-cultured freshwater eel. (a) Healthy freshwater eels under a stereomicroscope. (b) *Ichthyophthirius multifiliis* trophonts (arrows) attached to the head and operculum of freshwater eels (*Anguilla* sp.). (c) Trophonts of *I. multifiliis* on the fins of glass eels. (d) Individual trophonts with a visible horseshoe-shaped nucleus characteristic of *I. multifiliis* situated beneath the host's epithelium

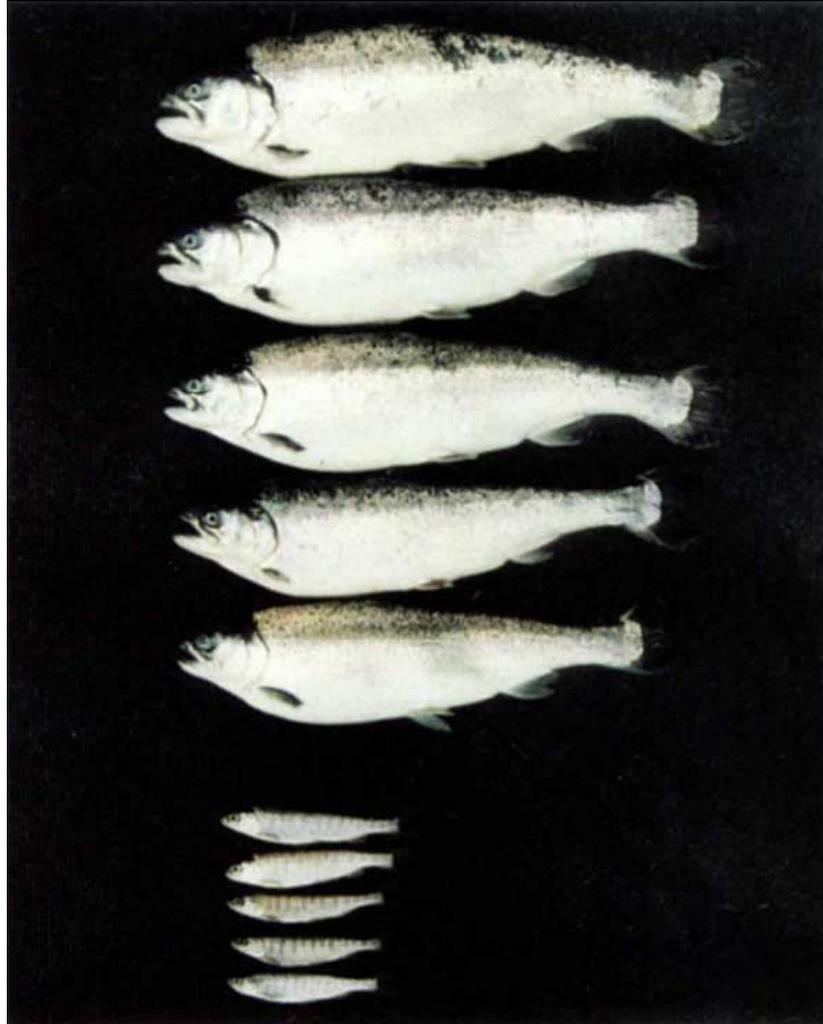


Cryopreservation



The technology of cryopreservation of fish spermatozoa (milt) has been adopted for fisheries industry.

GROWTH ENHANCEMENT



SCIENTIFIC CORRESPONDENCE

Extraordinary salmon growth

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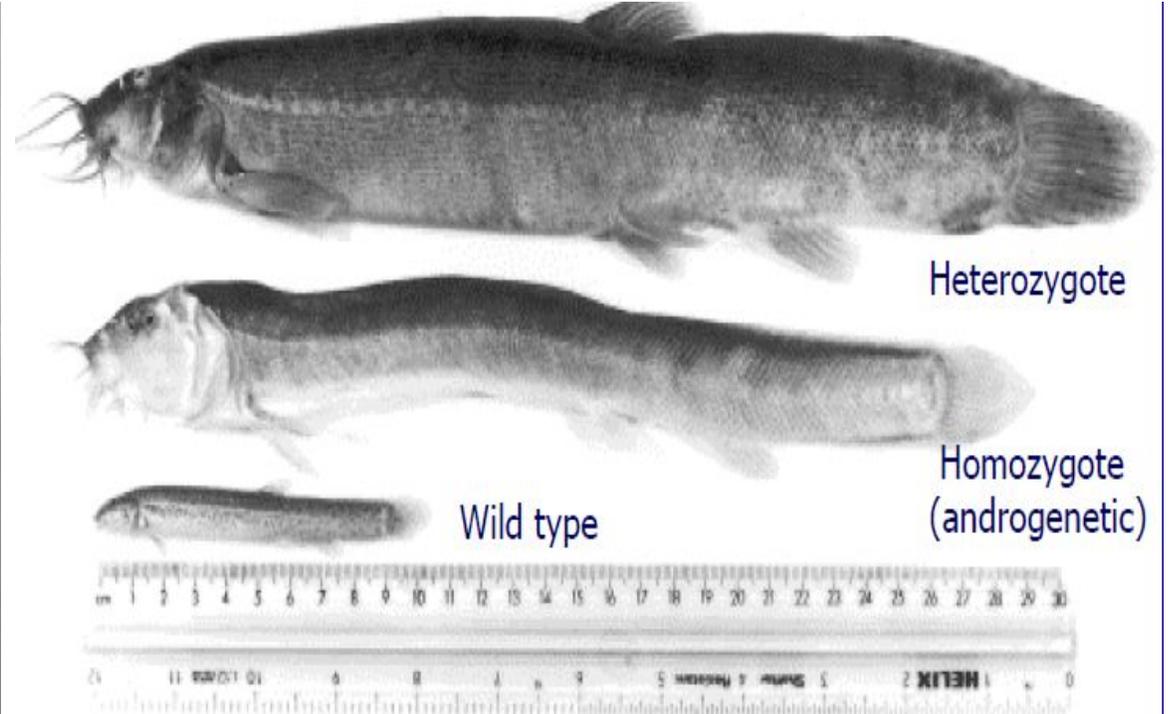


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TRANSGENIC



Transgenic growth enhanced-Tilapia



Transgenic growth enhanced-Loach

Source: Maclean and Laight (2000)

Aquaculture biotechnology in the Philippines



YY tilapia



Improved EXCEL tilapia



***Oreochromis spp.* Red Tilapia**



***Oreochromis hornorum* Hybrid**

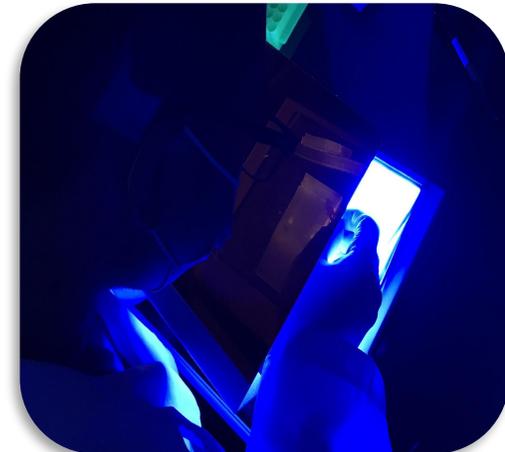


**GenoMar Supreme
Tilapia**

Source: Tilapia culture : the basics / Maria Rowena R. Romana-Eguia, Ruel V. Eguia, Rolando V. Pakingking, Jr. -- Tigbauan, Iloilo, Philippines : Aquaculture Dept., Southeast Asian Fisheries Development Center, 2020

Aquaculture biotechnology in the Philippines

- ✓ Emerging aquatic disease diagnostics
- ✓ Protocol development in molecular genetics
- ✓ Reproductive biotechnology
- ✓ Natural products development
- ✓ Species conservation initiatives
- ✓ Vaccine development



Induce Spawning Technology

What is it?

- Regulation of environmental condition or by introduction of hormones to stimulate factors that trigger reproduction.
- Promotes ripening of gonads and timely release of sperms and eggs



Induce Spawning Technology

- ✓ **Ease fishing pressure** from the wild and aid in species conservation and proper management.
- ✓ **Increase productivity**, provide fisherfolks an **alternative source of livelihood**, and **increase income**.



Induce Spawning Technology



Induce Spawning Technology

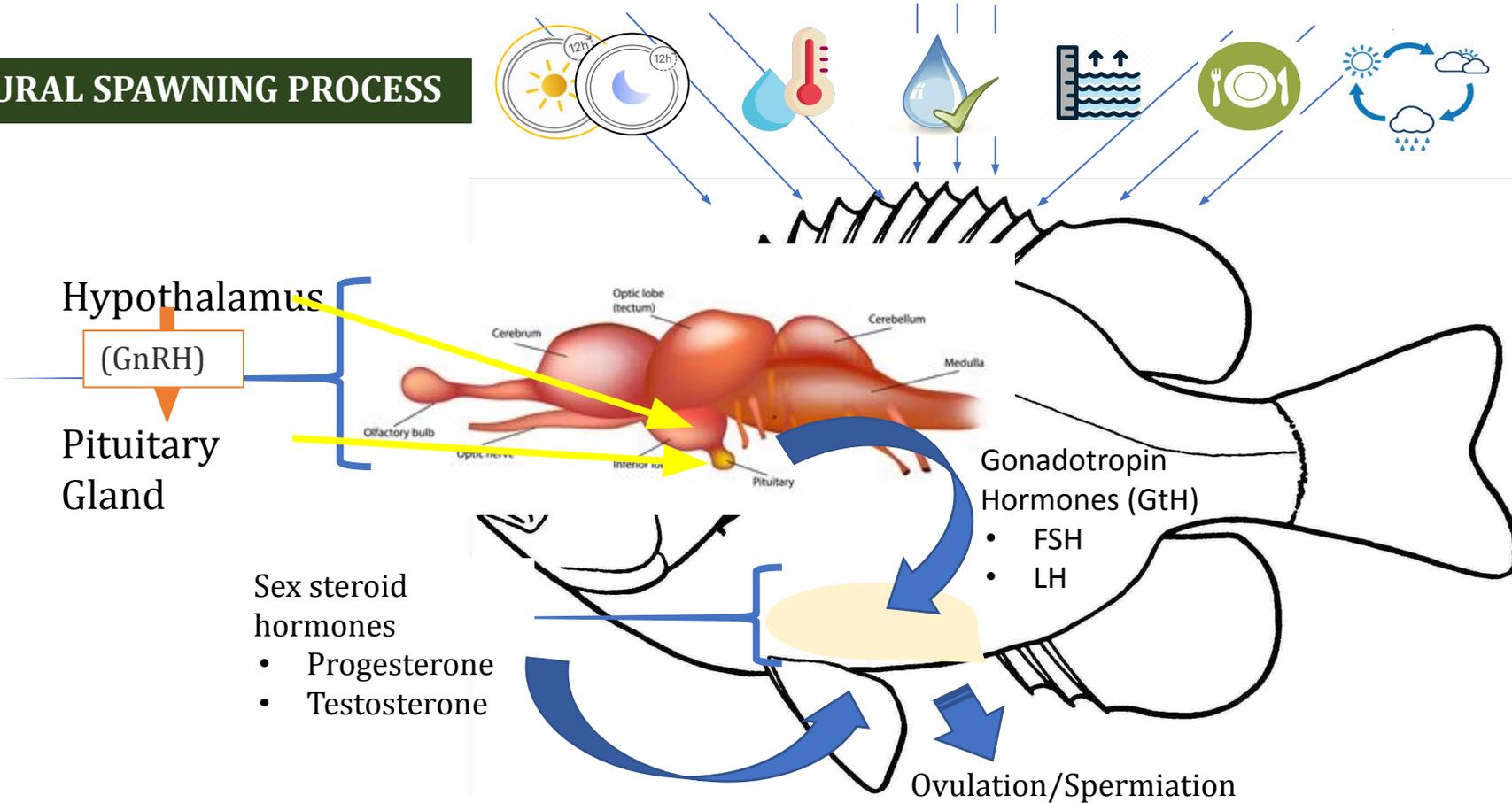
Why is it essential to aquaculture?

- ✓ The technique is very simple and does not need too much technical assistance or knowledge.
- ✓ Removes uncertainties in breeder spawning.
- ✓ Targeted/scheduled spawning is possible and can produce fry outside spawning season for hatchery and/or grow-out.
- ✓ Can provide pure spawn on fish under cultivation.
- ✓ Offers more controlled hatchery or aquaculture operations



The Spawning Process in Fish

NATURAL SPAWNING PROCESS



The Science Behind Induced Spawning

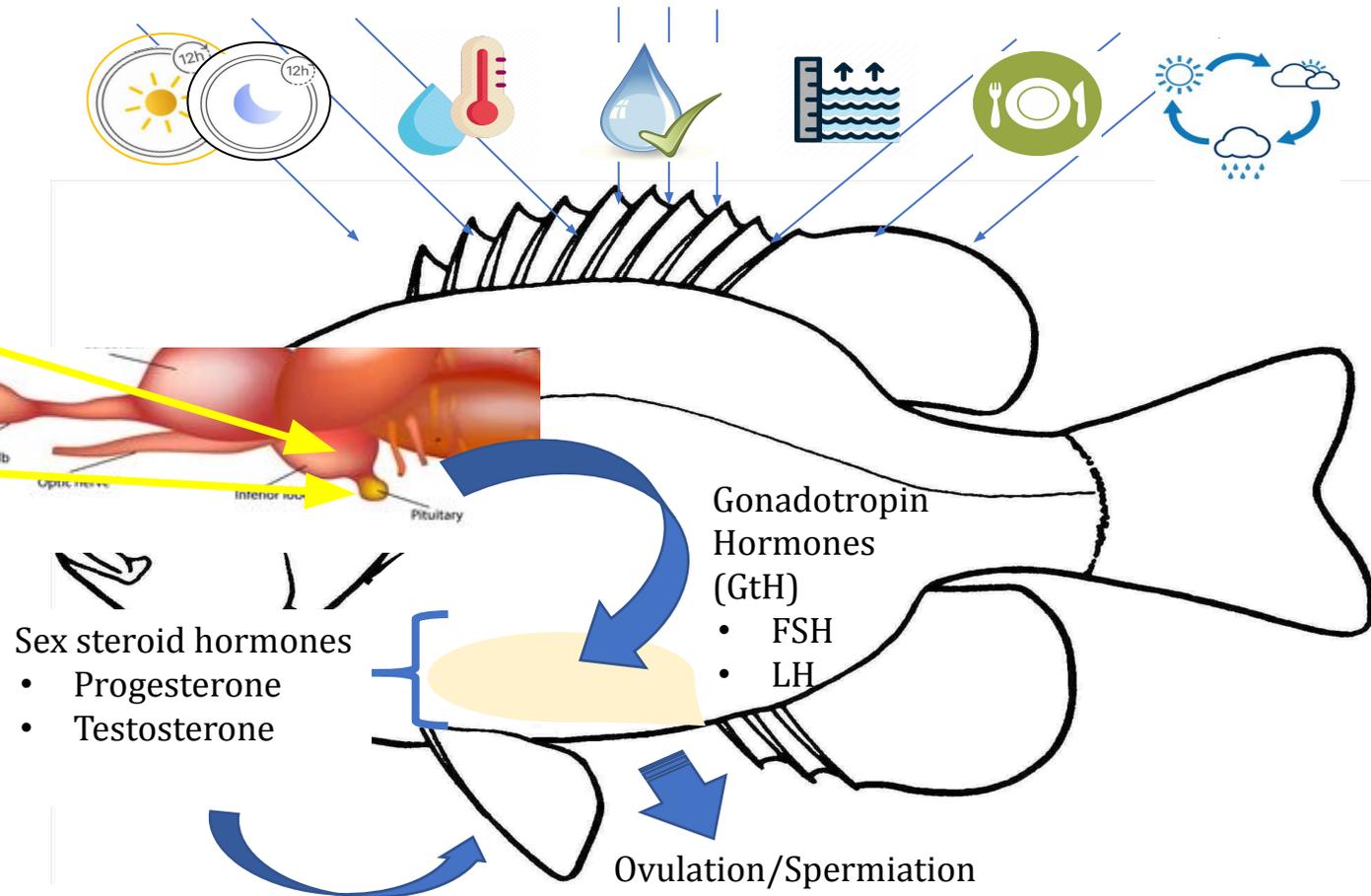
INDUCED SPAWNING

The objective is to bypass natural biological processes to speed up (or induce) spawning in fish

Hypothalamus

(GnRH)

Pituitary Gland



Induce Spawning Technology

INDUCED SPAWNING

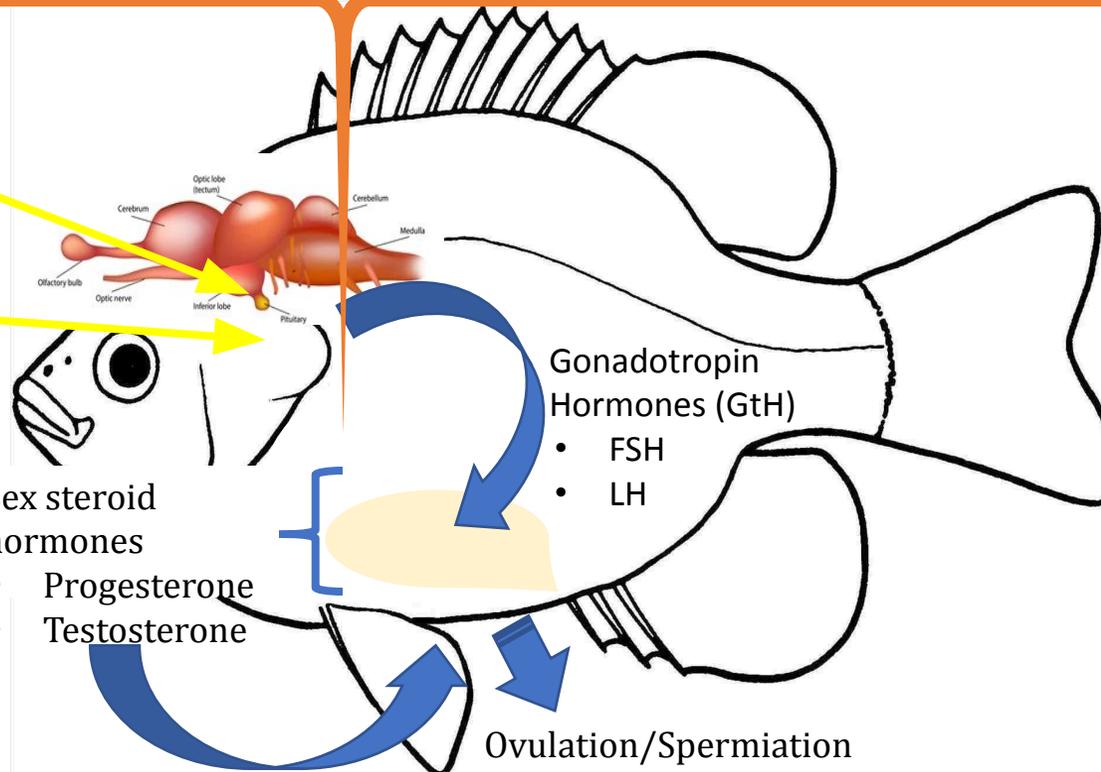


✓ Use of inducing agents

Hypothalamus

(GnRH)

Pituitary Gland



Gonadotropin Hormones (GtH)

- FSH
- LH

Sex steroid hormones

- Progesterone
- Testosterone

Ovulation/Spermiation

✓ Manipulate environmental conditions in captivity

TAKEAWAYS

- Biotechnology offers the aquaculture industry a powerful set of tools to meet the increasing demand for seafood sustainably and food security.
- On going research and innovation drive progress and offer solutions to complex challenges (disease management, resilient, sustainability, and resource optimization).
- Extend partnership and collaborations.

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